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A *Study* of an imagery test.

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of propositions has already reached a high level of development, if we accept Sheffer's analysis of the calculus of propositions, and it is by no means inconceivable that this should make a certain difference in their complete meanings. Moreover, it is not impossible that the notion of a "proposition," in the sense in which this word is used in the "Principia," may itself be capable of analysis in terms of some more simple notion—it is part of mathematical and logical progress not only that our sets of postulates should be rendered more precise by the adjunction of new postulates, but that the "habit" by which we use a set of postulates pertaining to a certain mathematical or logical system we use should be made more unambiguous by the reference of the system as a whole to a finer system, which gives us a smaller opportunity for ambiguity in the habit by which we use its postulates, as a center of orientation, as it were. There is no need, then, of supposing that even the axioms of the "Principia" or any similar set we shall ever come to are not subject to further analysis, and that we have an absolutely adequate knowledge of the meaning of any logical proposition whatever. Hence, although our degree of uncertainty in logic is so infinitesimal as not to enter at all in the allowance we make for error in our scientific reasonings, we have no reason to suppose it is altogether absent.

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### A STUDY OF AN IMAGERY TEST

IN Dr. Mabel Fernald's monograph, "The Diagnosis of Mental Imagery," the following test is described. Long words, such as somnambulist, symmetrical, etc., were pronounced to subjects who were then required to spell them backwards orally, and to report upon the process, noting especially any imagery which appeared to help in the performance of the task. The time taken to spell the word was noted on a stop-watch. Dr. Fernald writes:

"In general, we seem justified in saying that the results indicate that the rapidity of this form of spelling is favored by the ability to summon clear, vivid, and stable visual images of the words without a very great need for accessory factors. . . . We can not rely upon this as a purely objective test, since it would lead us into many errors of diagnosis. As a partially objective test, however, lending confirmation to the reports of the subjects, it would seem to be of greater value."

This test, though similar in principle to the Binet letter squares in which letters must be learned in a given position and then reproduced in some other designated order, and though it is also like the



postulate of Mr. Russell's is expressed in words, and not in symbols in recognition of the fact that, while this is the case, our power of doing so resides, not in the formulæ of logic themselves, but in our habit of using them. Now it is not only possible, but highly probable, that there are habits in accordance with which we might deduce different results from Mr. Russell's postulates, and possible, but almost infinitely improbable, that we might at any time mistake one of these habits for the proper one. It seems also possible to me that this chance of uncertainty might be reduced to any desired degree by the insertion of new postulates in Mr. Russell's system defining the mode of application of the previous ones. The negation of these would lead to non-Russellian logics much as the negation of the postulate of parallels leads one to non-Euclidean geometries. It appears to me unlikely that such an amplification of Mr. Russell's set of postulates would ever render it possible for us to prove that no further ambiguities in the habits according to which we use these postulates would be possible.

Apparently, then, it is in any case highly probable that we can get no certainty that is absolute in the propositions of logic and mathematics, at any rate in those that derive their validity from the postulates of logic. But are not the postulates themselves absolutely certain? Is there any conceivable room for uncertainty in the law of contradiction, or in the other axioms of logic? It appears to me that even here dogmatism is not the proper position to maintain. It seems a just maxim that we can not be absolutely sure that a proposition is true until we have a perfectly adequate knowledge of what it says—such a statement as, "Abracadabra, and I am sure of it" remains pure nonsense until one knows definitely what is meant by "Abracadabra," while even when we come to the relatively definite propositions of physics, such as the law of the conservation of energy, one of the chief sources of doubt as to their absolute validity is, in many cases, our lack of certainty as to what they really assert. Now, such "laws of thought" as the law of contradiction, or the law of identity, have already undergone a considerable change in their meaning on account of the analysis to which the new mathematical logic has subjected them—the law of contradiction, "Everything is either *A* or *not-A*," has been rendered a rather late inference in the "*Principia Mathematica*," limited in its meaning by the theory of types, and not derivable from any single one of the set of postulates there given. The law of identity has been shown to be a consequence of the definition of identity, which requires an elaborate logic for its very formulation. Even if one accepts "*p* is true or false" as the same proposition as the law of contradiction and "*p* is equivalent to *p*" as the law of identity, these may come in at a stage when the theory



Binet eight-year-old intelligence test which requires the subject to count backwards from twenty, has an advantage over these two. Fernald's test uses material which is already mastered in its original form, *i. e.*, the forward spelling of the word, and which is available in large quantities, so that the subject's reaction can be taken repeatedly. However, in a recent paper, Dr. Clara H. Town has called in question the validity of the test, on the basis of an experiment which she made upon six blind and six seeing persons. She says: "The tests in question have little or no value as objective tests for determining the use of visual imagery by a given individual."

A reliable diagnostic test of imagery seems to the present writer very important from a pedagogical point of view. A teacher needs to know the mental traits of the children with whom he deals, and children themselves may with profit be made aware of their own mental habits and of the changes which they might make in them. Hence it seemed worth while to gather more data on this test. I tried it with twenty-five adults and twenty-five children. The adults were all women, most of them college students between twenty and twenty-five years of age. The children were all girls between the ages of ten and twelve.

To adapt the test to these children shorter words were used than those in Fernald's list, and in order to cut down the rather large variations which she got, words of equal length were given. The first series consisted, then, of these fifteen words: *family, return, church, person, finger, pounds, handle, before, honest, figure, bundle, glance, always, pretty, custom*. Though these words are equal in length they proved to be somewhat variable in difficulty. The middle reading for the adults ranges from 4 seconds for the word *pretty* to 5.8 seconds for the word *church*. For the children the range lies between 6.4 seconds for *person* and 9.2 seconds for *custom*. The order of difficulty is not the same for adults and children, the correlation between the two orders being  $+ .36$ . A second series was also tried, containing fifteen words of nine letters each, as follows: *following, constancy, treatment, carpenter, different, respected, fifteenth, gentleman, everybody, separated, intensity, merchants, sometimes, daughters, Wednesday*. In cases where the words were unfamiliar to the children certain substitutes were given. These were, *beautiful, contained, selection, and relations*. I have not computed the relative difficulty of these words, but they, like the short list, would undoubtedly show differences, and I think this test would be much improved by choosing words from a standardized list such as Ayres has now published in "A Measuring Scale for Ability in Spelling."



At the beginning of each test the subject spelled a few preliminary words backwards and was questioned as to how she went about the task. The attempt was made to elicit spontaneous and circumstantial comments upon the imagery, and to avoid suggesting particular kinds of imagery. The reliability of the children's reports may seem especially open to question. My plan was, from my previous knowledge of these children and from preliminary questioning, to hazard a guess as to the child's imagery, and then to see whether she would make a statement and hold to it in the face of a contrary suggestion. This I found that they would often do. For example, to one whom I believed to have little visual imagery I said, "Do you seem to see the word?" She said "No I don't see it at all; I think it." "Don't you see it as if it were written or printed out?" "No, I just think it—like a voice." If I made a wrong guess and the child agreed with my suggestion, I then tried to get some detail about the image which should seem to mark it as genuine. For instance, I asked one child about her sound images, whose voice they were like. She answered, "Why it's a mixture of mother's voice and mine." Answers like that I take to be genuine. Judging, then, partly by the child's assured statement, partly by the spontaneity and naïveté of the statement, and partly by incidental signs, as when I heard the whispered spelling of the word forwards, or saw the child writing in the air with her hand, I felt some confidence in the accuracy of the children's introspections.

The kinds of imagery noted are designated as follows:

*Vis. whole.* Some persons were able to apprehend the word as a whole picture, and to spell it off as if reading the letters backwards from a printed page. They were not aware of depending on other cues.

*Vis. part.* Subjects reported fragmentary visual imagery of words. Sometimes it appeared syllable by syllable, sometimes in arbitrary groups, occasionally even letter by letter. Under this rubric are included those, also, who used visual imagery, but who did not see the word certainly as a whole.

*Mixed.* Those subjects are here counted as mixed in type, *a*, who use some visual images, but who change cues from word to word, *b*, who for each word use a combination of cues including the visual. Among them are certain cases in which the subject depends upon a visual image, but finds it necessary to pronounce the word in order to summon the picture.

*Doubtful.* Cases in which the subject could give no conclusive account, and cases in which I could not be sure that she was not influenced by the form of my question, are recorded as *d*.



*Aud.* and *art.* refer to those who used characteristically auditory or articulatory images.

*Gr. mot.* means grapho-motor, and the class *non-vis.* is used to cover the cases in which the subject could not specify her method further than by saying that it was certainly not visual. This term is not, therefore, exclusive of auditory, articulatory, etc., cases.

The distribution of the subjects among these imagery classes is as follows in Table I.

TABLE I

		Vis. Whole	Vis. Part	Mixed	D.	Aud.	Art.	Gr. Mot.	Non-vis.
Short words.	Adults.....	8	4	7	0	0	2	0	4
	Children.	5	4	3	3	2	6	1	1
Long words.	Adults.....	4	5	5	6	0	2	0	3
	Children.	2	2	3	5	2	5	1	1

The distribution of subjects according to speed is given in Table II. The time was noted on a stop-watch. The median of the fifteen reactions gives the subject her rank. Thus the number 9, Table II., means that there were nine adults whose median reactions took from three seconds up to (but exclusive of) four seconds.

TABLE II

Time	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	...	22	23	...	31
Ad...	0	9	7	4	2	2	1	0	0	0													
Ch...	0	0	1	1	4	5	5	4	2	0	1	0	0	1	0	0	0	0	.....	.....	1		
Ad...	0	0	0	3	5	4	4	2	0	2	0	2	0	0	3								
Ch...	...	...	...	...	...	...	...	...	2	3	5	0	2	2	0	3	0	1	.....	1	.....	.....	1

The children here show a normal distribution, whereas the curve for the adults is skewed to the left in the short series. Reference to the preceding table shows that whereas the visual and the non-visual methods are fairly evenly distributed among the children, the visual methods clearly outweigh the non-visual among the adults. In other words the visual image seems to go with the better speed. The factor of age might account for the absolute differences in speed, but it can not with certainty be made to account for the form of the distribution.

Table III. gives the median in seconds with its probable error for each subject, the type of imagery characteristic of the subject in this test, and the number of errors for the whole series. Table III. gives the records for the short words, Table IV. for the long words.



TABLE III

Adults					Children				
Subject	M	P. E.	Imagery	Errors	Subject	M	P. E.	Imagery	Errors
1	3	.6	vis. whole	0	1	4	1.2	vis. whole	0
2	3	.8	vis. whole	5	2	5	1	mixed	0
3	3.2	.4	vis. whole	0	3	6	1	aud.	3
4	3.2	.6	art.	0	4	6	1	vis. whole	1
5	3.4	.4	vis. whole	0	5	6.4	1.4	art.	0
6	3.6	.4	non-vis.	0	6	6.4	1.4	vis. whole	1
7	3.6	.6	vis. whole	0	7	7	1	d.	3
8	3.8	.6	vis. whole	2	8	7	1.2	art.	3
9	3.8	.6	mixed	0	9	7	1.3	vis. whole	0
10	4	.6	mixed	2	10	7.2	2	non-vis.	0
11	4.2	.6	vis. whole	0	11	7.6	1.2	vis. part	2
12	4.4	.8	non-vis.	1	12	8	1.2	vis. whole	2
13	4.6	.6	mixed	1	13	8	1.4	mixed	3
14	4.8	.6	mixed	0	14	8	2.4	d.	0
15	4.8	.8	vis. whole	0	15	8.2	3	vis. part	5
16	4.8	.8	vis. part	2	16	8.6	2.4	d.	0
17	5	.4	mixed	0	17	9	1.4	vis. part	1
18	5.2	1.2	mixed	2	18	9.2	.2	art.	3
19	5.4	.6	vis. part	1	19	9.2	3.2	art.	7
20	5.6	.6	vis. part	2	20	9.4	2	vis. part	1
21	6.4	1.4	mixed	1	21	10	1	gr. mot.	1
22	6.6	1.2	non-vis.	2	22	10	1.6	art.	1
23	7	.6	vis. part	1	23	12	2.6	aud.	5
24	7	1	art.	1	24	15.8	2	art.	1
25	8.2	2.4	non-vis.	7	25	23.4	12.6	mixed	11

TABLE IV

Adults					Children				
Subject	M	P. E.	Imagery	Errors	Subject	M	P. E.	Imagery	Errors
1	5.4	.6	vis. whole	1	6	10.2	1.2	vis. whole	3
6	5.6	.6	non-vis.	2	1	10.6	4	vis. whole	0
5	5.8	.8	vis. whole	0	2	11	3.2	mixed.	1
7	6	.6	d.	1	11	11.2	2.4	d.	2
9	6	1.4	mixed	0	5	11.8	2.2	art.	1
4	6.4	.8	art.	1	7	12	1.4	mixed	0
8	6.4	.8	vis. whole	5	3	12	1.4	aud.	0
3	6.6	1.4	vis. part	1	9	12.2	1.4	vis. part	0
11	7	1	vis. part	0	10	12.2	2.8	non-vis.	5
15	7	1.2	vis. whole	0	16	12.6	2	d.	1
2	7	1.4	mixed	5	4	14.2	3.4	vis. part	0
10	7	1.8	mixed	0	14	14.4	4	d.	3
12	8	1.2	d.	1	18	15	1.6	art.	1
14	8	1.8	mixed	2	8	15	3	art.	2
16	8.6	1.4	vis. part	0	21	17	2	gr. mot.	0
17	8.8	1.4	mixed	1	23	17.2	2.8	aud.	3
19	9.6	1	vis. part	3	22	17.4	4	art.	5
13	9.8	1.8	vis. part	3	20	19	2.8	mixed	5
21	11	3	d.	3	15	22.2	5.2	d.	7
20	11	3.6	d.	3	24	31.6	7.6	art.	4
18	13	3.2	d.	3	17	31.8	12.4	d.	2
24	13.2	2.6	art.	0					
22	16	1.8	non-vis.	2					
23	16	3.6	d.	3					
25	16.4	5.4	non-vis.	5					



From these tables it appears that with short words the middle reading for adults who use whole visual images is 3.5 seconds; P.E. .4; for those who use other forms (treating them as one class) 5 seconds P.E. 1. For children who use whole visual images the figures are 6.4 seconds, P.E. .6, and for the others 8.4 P.E. 1.3.

The long words give for the adults, vis. whole 6.1, P.E. .5, others, 8.6, P.E. 2.2. For children vis. whole 10.4, P.E. 4; and others 15, P.E. 2.8.

The average errors are, with short words, for adults vis. whole .8; others 1.35; for children vis. whole .8; others 2.5. With long words, adults, vis. whole 1.5; others 1.8. Children vis. whole 1.5; others 2.2. Thus there is an advantage throughout in favor of the vis. whole group. Those who use fragmentary visual imagery seem to be no better off than the non-visualizers.

*The Effect of Practise.* The medians of the first five, the middle five, and the last five reactions were noted for each subject. The result is that no clear practise effect is discernible. Of the adults in the short series 10 grew worse, 4 remained the same, and 11 grew slightly better. Of the children 18 grew slightly worse, 2 remained the same, and 5 improved slightly. In the long series 12 adults improved and 13 deteriorated, 10 children improved and 11 deteriorated. The changes were slight and in general are smaller than the probable error. This result speaks in favor of the usefulness of the test, as it is not likely to be vitiated by the fact that many children play games or use codes in which spelling backwards is a feature.

*Conclusion.* It is desirable that the test be tried with more subjects, including men and boys, and also with a list of more perfectly standardized words. The present results seem to me to support Dr. Fernald's estimate of the test as quoted above. Dr. Town's method may account for the difference in her results. In her report she uses "seeing subjects" as the equivalent of "visualizers." The assumption that all seeing persons use visual imagery in a test like this is entirely unwarranted, and it makes Dr. Town's results quite meaningless, it seems to me, so far as the imagery problem is concerned. It should be said, finally, that although this test may prove to be a useful accessory in classifying persons according to their imagery, yet it does not indicate that a person belongs to such and such a general imagery type. In other words a person may be a visualizer in the kind of performance which the test represents, but may be something different in other enterprises.

KATE GORDON.



## REVIEWS AND ABSTRACTS OF LITERATURE

*The Philosophy of Giambattista Vico.* BENEDETTO CROCE. Tr. R. B. Collingwood. New York: The Macmillan Company. 1913. Pp. xii + 317.

The effort of Croce to create a place for Vico in the history of philosophy can be understood on two grounds: a patriotic devotion to Italian culture and the feeling of a certain like-mindedness whereby Croce sees in Vico a forerunner of his own thought. But the way of the patriot is hard, for, in his own day "at most, Vico acquired the reputation of a scholar amongst hundreds of scholars, a man of letters among thousands of similar men; a learned man but nothing more" (p. 261), and in spite of Croce's best efforts to find traces of his thought in later centuries the results are most meager. On the other hand, the like-mindedness between Croce and Vico is real, often in defects as well as in merits. Both lack the architectonic sense that makes constructive exposition possible and both indulge in a loose use of terms that is the despair of an exact student. Yet both exhibit a certain acuteness of large-scale vision that makes their thought, after all, worth while.

Croce's exposition "is not meant for a summary of Vico's writings work by work and part by part" (p. vii). It is rather an evaluation of Vico's thought and might well be entitled, after the analogy of one of Croce's other writings, "The Truth in Vico."

The first two chapters are devoted to the theory of knowledge. This theory arose in direct opposition to Cartesianism. Clear and distinct perception is not the criterion of truth, but rather "the condition under which a thing can be known is that the knower should have made it, that the true is identical with the created: *verum ipsum factum*" (p. 5), from which it follows that God alone possesses science, man only consciousness; and metaphysics, theology, and physics are depreciated. Most striking is the limitation imposed upon mathematics by this point of view." From metaphysics, geometry takes the point by drawing it, that is, by annihilating it as a point, and arithmetic the unit by multiplying it, that is, by destroying it *quâ* unit. But since metaphysical truth, however certain it may seem to consciousness, is indemonstrable, mathematics itself rests in the last resort upon authority and probability" (p. 12). Therefore, mathematics as derived from metaphysics, can not be a basis of other sciences, although they follow it in order of derivation. From this we are led to the astounding conclusions that science has never made any discoveries through the mathematical method, while without it all goes well.

However, Catholic faith, acquaintance with the moral sciences, and the study of law worked together to lead Vico to modify these conclusions on the basis of his theory of knowledge. Man can know his social world because he has made that world. But in mathematics, as in moral science, it is a question of dealing with man's own creations, of placing facts in ideal constructions, and the mathematical method is reinstated as



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